SLAC-PUB-1191
(A)
March 1973

EXPERIENCE WITH TOUCH PANEL CONTROL AT SLAC*

W. C. Struven

Stanford Linear Accelerator Center
Stanford University, Stanford, California 94305

Introduction

The touch panel man-machine interface system was developed at SLAC to help implement control room consolidation. The decision to consolidate the two accelerator-research area control rooms was made in 1970 in order to increase operating efficiency.[1] An acoustical touch panel was proposed and developed.[2] A cross-wire touch panel was implemented when it appeared that it could be produced more quickly and at a lower cost. We now have eight cross-wire systems and one acoustic system installed as control surfaces in our Main Control Center. These control surfaces are mounted over standard C.R.T. video monitors to form the control-display unit. We chose this method of control and display over competing systems such as light-pen units because of the ease of control. Light-pens become a burden when several displays are mounted side-by-side. The operator is required to make many changes on all three units of a group and the use of light-pens would be too time consuming.

The touch panel method of control is made possible by a Data Disc Storage drum connected to an SDS-925 computer. The Data Disc has a complete character generator and appropriate drivers for the C.R.T.displays. "Touches" are sensed by the SDS-925 computer and "read" as operator requests. A button typically selects another panel, selects a pattern (trigger pulse), turns a device on or off or raises or lowers a voltage or current. All controls go to the accelerator via a DEC PDP-9 computer in the Central Control Room (CCR).

The organization of touch panel displays was made much like the "manual" control panels which they duplicated, however, an exact one-to-one relationship of controls, status and analogs is not possible.

Touch Panel Organization

We concluded that three adjacent touch panels would suffice at each control position. A method was provided so that one "touch" would call and display either one, two or three displays on the three panels. We have found that it is less confusing if each display is selected individually from an "index" display on each panel. Most of the present display programs are written in this manner.

Each C.R.T. display has been divided into 512 "x" and 512 "y" coordinates. The coordinates do not appear on a panel but are used as a guide while programming. Ten horizontal "buttons" and thirteen vertical "buttons" can be programmed on a panel. Typically, a maximum of 60 buttons appear on any panel. All button locations have been provided with "finger holes" to aid in locating controls. In addition, status and analog information can also be programmed at selected locations. Each touch panel programmer has experimented with button, status and analog grouping. At this time, we have many "typical" panel layouts but we expect to standardize these layouts when we have more operating experience with various combinations. Three "classes" of panels have been written. One group - "operations panels" are functionally oriented; for instance, when a beam-line button is selected, only the controls pertinent to that experimenter's beam are active. This is true for any selected panel in a group of three. A second group of "maintenance panels" are hardware oriented. The "maintenance panel" series was written to aid checkout of the touch panel controls and is now used primarily by maintenance technicians. A third series of "experimental panels" is used to test new concepts both in programming and hardware and is partially hidden from the machine operators. As each new panel is proven, it is re-indexed as an "operation panel" or a "maintenance panel".

We have added manual controls as well as equivalent touch panel controls as new signals were defined. The manual control system is our fallback position; however, new touch panel controls may or may not have a manual equivalent. This dual concept of manual controls in one location (CCR) and touch panel controls in another (MCC) has required the addition of manual/touch panel transfer circuits and additional systems programming. We feel that this is an interim problem that will disappear when we are completely consolidated in MCC.

Panel Features

Each button can have two lines of six alpha-numeric characters displayed inside of a button. The location of these twelve characters is fixed; however, spaces can be used for variation of the displays.

Status can be displayed in several ways: a heavy outline button or normal outline, a dynamic text display or binary bits, all of which can be specified as to location.

Analogs can be displayed in the following ways: raw digital values which are proportional to the dc signal, or scaled analogs, i.e., 0 to ± V, or -V or +V. These options are readily available to the panel programmer. In addition, we can display a vertical or horizontal bar graph which is proportional to the raw analog. In the future, we intend to provide scaled bar graphs.

Static text can be displayed at any designated position with several options: normal width and height, double width and height or any combination of these.

When a new panel is selected, it is written on the C.R.T. in about one second. This writing time has been reduced over the initial time of 2 to 3 seconds to minimize operator response time.

Panel Program Preparation

At SLAC we have an IBM 360-91 Central Computer facility with 45 time-shared terminals around the project. The time share program (WYLBUR-HASP) is a very convenient way to prepare or modify a panel. All panels are kept on disk-pack files and can be accessed from any terminal. New or modified panel statements can be entered and submitted to a 360 program que. A "panel compiler" is resident in the 360 system and is used along with data files to compile a deck of cards for each panel. At present, these cards must be hand-carried from the 360 facility to the SDS-925 computer in MCC. Panels are read into the SDS-925 drum using a 180 card/min. reader. When they have been loaded into the panel store, they can be called from any or all of nine touch panel displays.

A listing is produced by the 360 "panel compiler" with each deck of cards. Each listing has a diagnostic section to aid in debugging the panel. Each listing also contains a graphic display which is printed to approximate scale so that a visual check can be made of a panel layout.

*Work supported by the U.S. Atomic Energy Commission.
(To be published in the Proceedings of the 1973 Particle Accelerator Conference, San Francisco, Cal., March 5-7, 197

Applications

To date over fifty panels have been written to control the accelerator and special magnetic elements in the beam switchyard. The complete accelerator pattern (trigger) system has been written on a series of five panels. We have also implemented a frequency/divider display to scale the pulse rates of up to 8 sequential beams. The pattern system has been completely implemented in software and allows all of the important manual scaling features to be retained. These panels and their associated software can produce pre-triggers, as well as pulse delays and null pulses as required by an experimenter.

We have provided a special "error message" display. This panel rolls new alpha-numeric information into the bottom of the display and rolls old messages out of the top. We are planning to implement classes of messages, that is, emergency messages, routine messages and real time displays in the near future.

We have also provided special "mini" messages to be used by the panel programmers such as klystrons on, klystrons off, pattern priority and beam line assignments.

We have provided a teletype keyboard panel which can be used as a remote input to the SDS-925 computer by system programmers.

Non Touch Panel Controls

Certain displays do not use the computer touch panel system. We have chosen to display such signals as Linear Q, x and y positions of the beam and the Panofsky Long Ion Chamber (PLIC) signals on oscilloscopes. Hardwire CCR alarms and klystron gallery video signals are also transmitted and displayed outside of the touch panel system.

Conclusion

We now have an operational system. Virtually every CCR control, status, pattern and analog is available on a panel display. Panel modifications now require about 24 hours. In the near future, we intend to link the laboratory 360-91 computer to the CCR PDP-9 computer so that panel changes can be made during an operating shift, processed by the 360-91 and directly loaded into the touch panel display system. If an experimenter asks for a control which is not readily available, an operator could add it to a panel by a small program change. An on-shift regrouping of controls will be possible if accelerator hardware fails and a substitute control must be used.

This touch panel system should find application in other fields such as computer aided education and computer aided drafting.

References

1. K. Breymayer, T. Constant, K. Crook, J. Hall, T. Huang, D. Reagan, P. Sandland and W. Struven, "SLAC Control Room Consolidation Using Linked Computers," Report No. SLAC-PUB-866, 1971 Particle Accelerator Conference, Chicago, Illinois, March 1-3, 1971.
2. D. Fryberger and R. Johnson, "An Innovation in Control Panels for Large Computer Control Systems," Report No. SLAC-PUB-876, 1971 Particle Accelerator Conference, Chicago, Illinois, March 1-3, 1971.